Integrated Resource Inventory

Physical Land Classification of the Jean D'Or Prairie Area

Alberta
ENERGY AND NATURAL RESOURCES
Resource Evaluation and Planning

PHYSICAL LAND CLASSIFICATION
OF THE
JEAN D'OR PRAIRIE STUDY AREA

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for

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20. Lakeland
21. East Beaver Lake
22. Easy and Dry Creeks
23. Sunland Drainage
24. Chungo-Cline-Nordegg Area

This report is to be used in conjunction with the 1:50 000 scale Physical Land Classification (PLC) maps of the Jean D'Or Prairie study area for the 84J 3, J4, J5, J6, J11 and J12 maps sheets. The maps are available from the Alberta Map and Airphoto Distribution Centre, 2nd Floor, North Petroleum Plaza, 9945 - 108 Street, Edmonton, Alberta, T5K 2G6.

ABSTRACT

The Physical Land Classification of the Jean D'Or Prairie area was initiated to provide basic data on the geology, geomorphology, landforms, soils and drainage of the area and to determine their extent and distribution.

The project area is part of the plains of north-central Alberta and lies within the Vermilion Lowlands. The terrain's surface expression is primarily undulating with occasional low level areas. Wabasca and Peace Rivers form the main drainage systems.

The main physiographic region of the area is the Vermilion Lowland. The region is further subdivided into four sub-regions: the High Level Plain, Boyer Plain, Jean D'Or Plain and Mikkwa Plain. Several geomorphic systems and units have also been identified within these sub-regions based on the distinct patterns of landforms, soils, parent materials, texture and drainage.

The study area underwent glaciation during the Pleistocene Epoch. The Loon River Formation consists of stratified dark gray marine shales of Lower Cretaceous period. The bedrock outcrops are restricted only to the steep banks of Wabasca River.

The predominant soils in the Jean D'Or Prairie area are Gray Solodized solonetz soils, Humic Luvic Gleysols, Orthic Humic Gleysols, Eluviated Eutric Brunisols and to a lesser extent Mesisols, Cumulic Regosols and Rego Gleysols. Also scattered throughout the study area are low-lying organic soils, primarily Terric Mesisols which have developed from fen peat.

The study area lies within the dry Mixedwood and moist Mixedwood sub-regions of Boreal Mixedwood Ecoregion (Strong and Leggat 1980). The dominant overstory vegetation consists of aspen with lesser quantities of balsam poplar. Roses, willows, dogwood and cranberry constitute some of the understory vegetation.

The climate of Fort Vermilion is described as cool continental with long cold winters, short warm summers and relatively low precipitation (Scheeler and Macyk 1972). Average annual precipitation is approximately 300 mm and ranges from 227 to 512 mm. The mean annual temperature is approximately -3°C but rises to 16°C during July and August. The frost-free period is approximately 75 days.

The predominant soils in the Bear Draw Prairie area are Gray Solonetzic Luvisolic soils, Black Solodic Chernozemic, Orthic Humic Gleysols, Eluviated Eutric Brunisols and to a lesser extent Mesisols, Cumulic Regosols and Rego Gleysols. Also scattered throughout the study area are low-lying organic soils, primarily Terric Mesisols which have developed from fen peat.

The study area lies within the Dry Mixedwood and Boreal Mixedwood sub-regions of Boreal Mixedwood Ecoregion (Strong and Leggat 1992). The dominant overstorey vegetation consists of aspen with lesser quantities of balsam poplar. Roses, willows, Saskatoon and chokecherry constitute some of the understorey vegetation.

The climate of Fort Vermilion is described as cold continental with long cold winters, short warm summers and relatively low precipitation (Chetner and Wells 1974). Average annual precipitation is approximately 380 mm and ranges from 307 to 431 mm. The mean annual temperature is approximately -1°C but rises to 16°C during July and August. The frost free period is approximately 80 days.

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PREFACE

This study was undertaken to provide baseline information for the Renewable Resources Inventory Section, Natural Resources Information Services of Alberta Energy and Natural Resources. The physical land classification information is useful to other government agencies monitoring specific resources such as forestry, fish and wildlife, public lands and agriculture.

ACKNOWLEDGMENTS

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The author also thanks the staff of the Renewable Resources Inventory Section for their helpful comments and suggestions, and Ed Karpuk who initiated the project, conducted the field work, prepared maps and wrote the first draft of this report.

1. INTRODUCTION

1.1 Location and Extent

The Jean D'Or Prairie study area covers approximately 1 412 km^2 (545 sq. mi.) in north-central Alberta (Figure 1). The boundaries of the area are irregular and lie between Townships 104-111, and Ranges 6 and 13 west of the 5th Meridian. The settlement of Fort Vermilion is adjacent to the western boundary south of the Peace River. The river flows from west to east through the study area. Human activities in the area are restricted to agriculture in the northwest and hunting and trapping throughout the area. Access is generally restricted to the north and west margins.

1.2 Physiography

Jean D'Or Prairie lies entirely within the north-central Alberta plains. Topographic elevations range from 244 to 457 masl (800 to 1 500 ft.). The terrain has an overall undulating to level topographic expression with occasional sharply cut valleys found, particularly along the river banks. Bedrock outcrops are few in the plains and only found in stream banks and gullies.

A dense network of rivers, creeks and streams blanket the study area. The rivers, creeks and streams flow in a general west-east and southwest-northeast direction. The Peace and Wabasca Rivers constitute the main drainage systems for the map area.

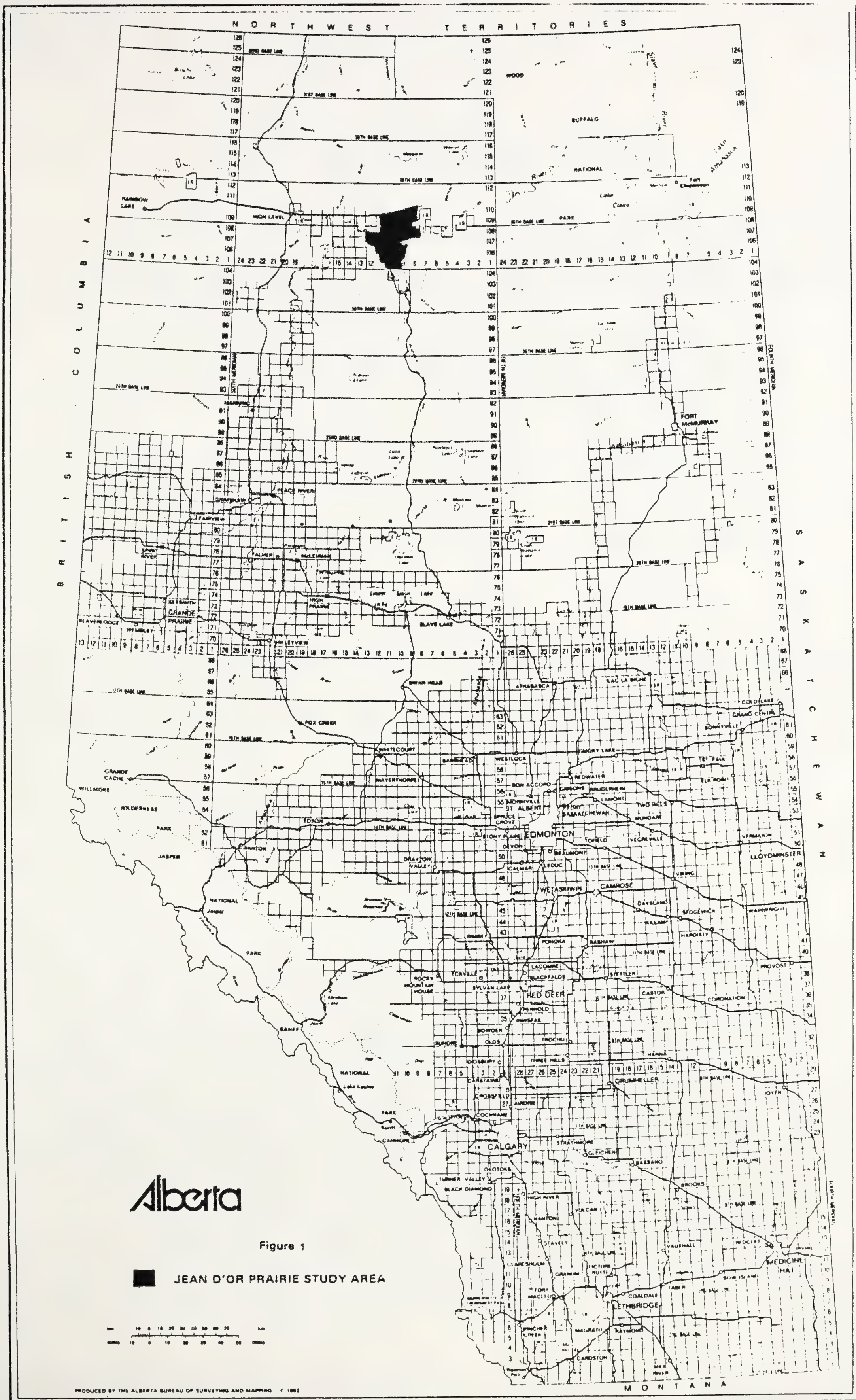


Figure 1

JEAN D'OR PRAIRIE STUDY AREA

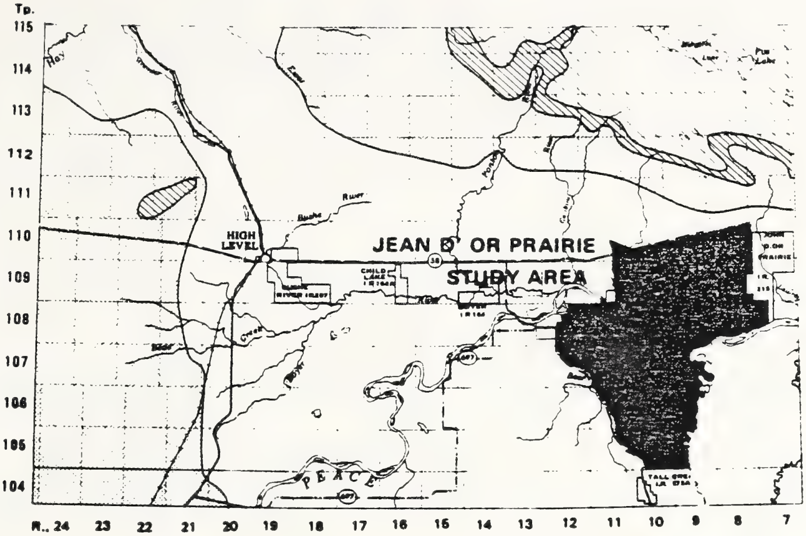
1.3 Bedrock Geology

The entire project area is underlain by bedrock of early Cretaceous Loon River Formation and consists of medium to dark gray, micromicaceous, somewhat fissile, marine shale with some sandstone, siltstone and ironstone (Figure 2). The Loon River Fomation is entirely marine in origin with varied thicknesses throughout the region. The formation decreases in thickness towards the north with 305 masl (1 000 ft.) in the vicinity of the town of Peace River while averaging 50 masl (165 ft.) in the study area (Law 1955).

Within the study area, the Loon River Formation is overlain by glacial and post glacial deposits. The bedrock is exposed only in the stream cutbanks. The base of the Loon River Formation is marked by unconformably truncated non-marine sandstone, shale and coal beds of the subsurface Gething Formation.

1.4 Quaternary History

The study area lies within the lower portion of a broad basin once inundated by Glacial Lake Tyrrell. This large irregular body of water at its maximum extent covered the basins of the lower Peace and Athabasca rivers and the low relief terrain in what is now the Peace-Athabasca Delta (Taylor 1960). The lake was formed from meltwaters flowing from a retreating Laurentide continental ice mass which left northern Alberta approximately 10 000 to 11 000



SCALE 1 : 1 500 000

LEGEND

UPPER CRETACEOUS

SMOKY GROUP - Dark gray marine shale and silty shale and thin beds of ironstone concretions

DUNVEGAN FORMATION - Gray deltaic to marine fine-grained, feldspathic sandstone with hard calcareous beds, laminated siltstone and gray silty shale

SHAFTESBURY FORMATION - Dark gray marine fish-scale bearing shale; silty in upper part, nodules and thin beds of ironstone concretions, bentonite partings; thin silt and sand in lower part

LOWER CRETACEOUS

LOON RIVER FORMATION - Dark gray marine fossil-rich shale and laminated siltstone; nodules and thin beds of ironstone concretions

Figure 2 BEDROCK GEOLOGY ~~IN~~ THE VICINITY OF JEAN D'OR PRAIRIE STUDY AREA (Reproduced from Scheelar and Macyk, 1972 and Green, 1970)

years ago (Prest 1970). The study area is in the portion of the Lake Tyrrell basin constricted between the Caribou Mountains and Buffalo Head Hills. The Peace River also drains into this lake from the southwest.

The thickness of glaciolacustrine sediments varies in the study area. Thin veneer and blankets of lake bottom sediments over moraine are found in the northern and southern third of the study area. These thin deposits were laid down in the shallow waters of the lake perimeter. The central third of the study area represents the deepest portion of the lake basin. Sediments laid down in this portion of the basin are thicker (greater than 2 m) than the deposits near the perimeter.

The different thicknesses of lake sediments exhibit their own unique physiographic features. The thin veneers and blankets fail to completely mask the topographic expression of the underlying ground moraine. Numerous east to west oriented poorly drained, linear, organic filled depressions are evident in the northern and southern third of the study area. These features represent morainal flutings which show up through the thin lake deposits.

The thicker lake deposits in the central portion of the study area mask the underlying morainal terrain. The thick deposits exhibit their own microtopographic surface expression in the form of small, regular mounds called "humpies" (Odynsky 1971). These mounds are characterized by circular shapes with central depres-

sions. Humpies average 91 m (300 ft.) in diameter with 5 m (15 ft.) height and are 1 to 1.2 m (3-4 ft.) lower than the outer rim of the mound. The size and composition of the humpies make it seem logical that they must be ice-depositional features of some type. Humpies are believed to have originated as debris-filled pits on a stagnant ice surface and that the melting of ice surface left the pit fillings as humpies (Gravenor 1955, Gravenor and Kupsch 1959). Although these mounds vary in relief by only a few metres, the variations in drainage are dramatifc. Conditions range from well drained in the upper portion of the mounds to imperfectly to poorly drained in the intervening depressions.

North of Peace River, the sediments thin out to the north exposing a small band of slightly stony continental basal till within the study area. This till deposit is the southerly extension of morainal deposits which cover the south facing slopes of the Caribou Mountains in the north. This till was deposited by a Laurentide or continental ice sheet which advanced into the area from the northeast. The origin of this ice sheet was in the Northwest Territories, west of Hudson Bay. Like the glaciolacustrine sediments, the till is derived primarily from the underlying Loon River shales.

During the later stages of Lake Tyrrell, a major river system entered the lake from the west and deposited a large Pleistocene delta. As the lake lowered and retreated to the east a broad stream channel was formed. This channel was connected to the delta

and followed the same course as the present Peace River. The deltaic deposits are found outside the study area to the west and grade into fluvial deposits in the study area. These deposits are thin veneers over glaciolacustrine sediments. Recent fluvial activity has dissected these fluvial deposits forming shallow channels in the eastern portion of the study area. These channels were later abandoned. They remained poorly drained and became eventual sites for organic deposits.

The total disappearance of Lake Tyrrell exposed the lake deposits to various fluvial geomorphic processes. Sheet flow discharging off the Caribou Mountains washed lake sediments into irregular fan-shaped areas of fluviolacustrine material north of the Peace River. South of the river is a broad area of fluvio-lacustrine sediments which was probably laid down by waters draining from Lake Tyrrell during its latter stages.

The present day Peace River, Wabasca River and their tributaries have incised channels into the surficial deposits and underlying bedrock formations in the study area and vicinity. Recent fluvial processes have resulted in the development of floodplains, terraces and strong to steep valley slopes. Some colluvium is evident on steep cutbanks of the Peace and Wabasca River valleys.

2. METHODOLOGY

2.1 Physical land Classification Guidelines

The Physical Land Classification (PLC) methodology (Land Classification Section 1977) was developed to meet the physical land resource data requirements of the resource planning and management agencies of Alberta Energy and Natural Resources and other governmental and research organizations. It is recognized that comprehensive resource evaluation and planning requires physical land data as one of the primary components of any environmental study. The data was obtained by implementing a methodology which classifies the physical landscape according to its mode of origin, composition and form.

The methodology is based on a four level hierarchy (Table 1). The classification starts at the broadest and most general level (physiographic region), then progresses through the hierarchical sequence and ends with the delineation of highly detailed geomorphic units. This hierarchy provides a logical framework which allows for the subdivision of delineated areas at one level into more detailed areas at the next lower level.

Table 1

LEVELS OF CLASSIFICATION

Classification Level	Delineating Criteria	Scale of Derivation
Physiographic Region	Elevation, relief and structural geologic formations.	1:1 000 000 to 1:3 000 000
Physiographic Sub-region	Definite patterns of relief, geology and geomorphology.	1:500 000 to 1:1 000 000
Geomorphic System by Genetic Composition	Recurring pattern of landforms distinguised (surficial materials) and surface expression.	1:50 000 to 1:250 000
Geomorphic Unit	Homogeneous areas of land with inherent properties of genetic composition (surficial material), surface expression, texture, slope (type and %), aspect, erosional and depositional modifiers, integration of soils (subgroup level - CSSC) and internal drainage (CSSC).	1:5 000 to 1:50 000

2.2 Interpretation

The identification and classification of the physical land parameters of the Jean D'Or Prairie study area was based on the interpretation and integration of relevant information from published and unpublished references, airphoto interpretation and field investigations. One major reference used in this project was the Soil Survey of the Mount Watt and Fort Vermilion Areas, by Scheelar and Macyk (1972). This report gave extensive information on the soils, surficial geology and topography of the study area.

The physical land classification of the study area was done on 1:50 000 scale black and white aerial photography dated September 19, 1978. The final PLC information was transferred onto 1:50 000 topographic series base maps.

2.3 Field Procedures

Field work was conducted by Ed Karpuk during July, August and September, 1980. A total of 15 days was spent doing field work. Access to selected field sites was provided by truck and helicopter. Areas accessible by truck were the roads in the northeastern, northern and western perimeters as well as the agricultural areas in the northwest portion of the study area. The remainder of the study area was reached by helicopter.

Sample sites were identified on the 1:50 000 aerial photographs before going into the field. These sites were chosen in areas considered representative of major geomorphic systems and units in the study area. Pits were dug at each site to determine the soil properties and parent geologic material. In the pits, mineral soils were classified on the basis of horizon characteristics such as thickness, texture, structure, internal drainage, color, consistency, boundary features, presence of $CaCO^2$ and pH. Work at each field site also included determining the topographic expression, slope and aspect of the surrounding terrain.

3. PHYSICAL LAND CLASSIFICATION

3.1 Vermilion Lowland Physiographic Region

The study area occupies the lowest elevations of the Vermilion Lowland (Pettapiece 1980). Elevations in the study area average around 270 masl (900 ft.). This lowland gradually rises north toward the Caribou Mountains and south toward the Buffalo Head Hills. The Lowland represents the basin in which postglacial waters collected to form Glacial Lake Tyrrell. Loon River marine shales and siltstones underlie the entire study area and most of the Lowland region. Relief in the study area is low which is characteristic throughout the Lowland region.

The Lowland in the study area is subdivided into four physiographic sub-regions. Each sub-region is distinguished on the basis of relief patterns, geology and overall geomorphology. The names of these sub-regions have been adopted from Pettapiece's (1980) preliminary physiographic map. The four sub-regions are the High Level Plain, Boyer Plain, Mikkwa Plain and Jean D'Or Plain (Figure 3). Both the High Level and Mikkwa Plains occur in remnants of the Lake Tyrrell basin. The portion of Boyer Plain in the centre of the study area corresponds to the lower part of a large Pleistocene delta which formed at the mouth of the Peace River during a period of standstill in Lake Tyrell's history. The Boyer Plain grades

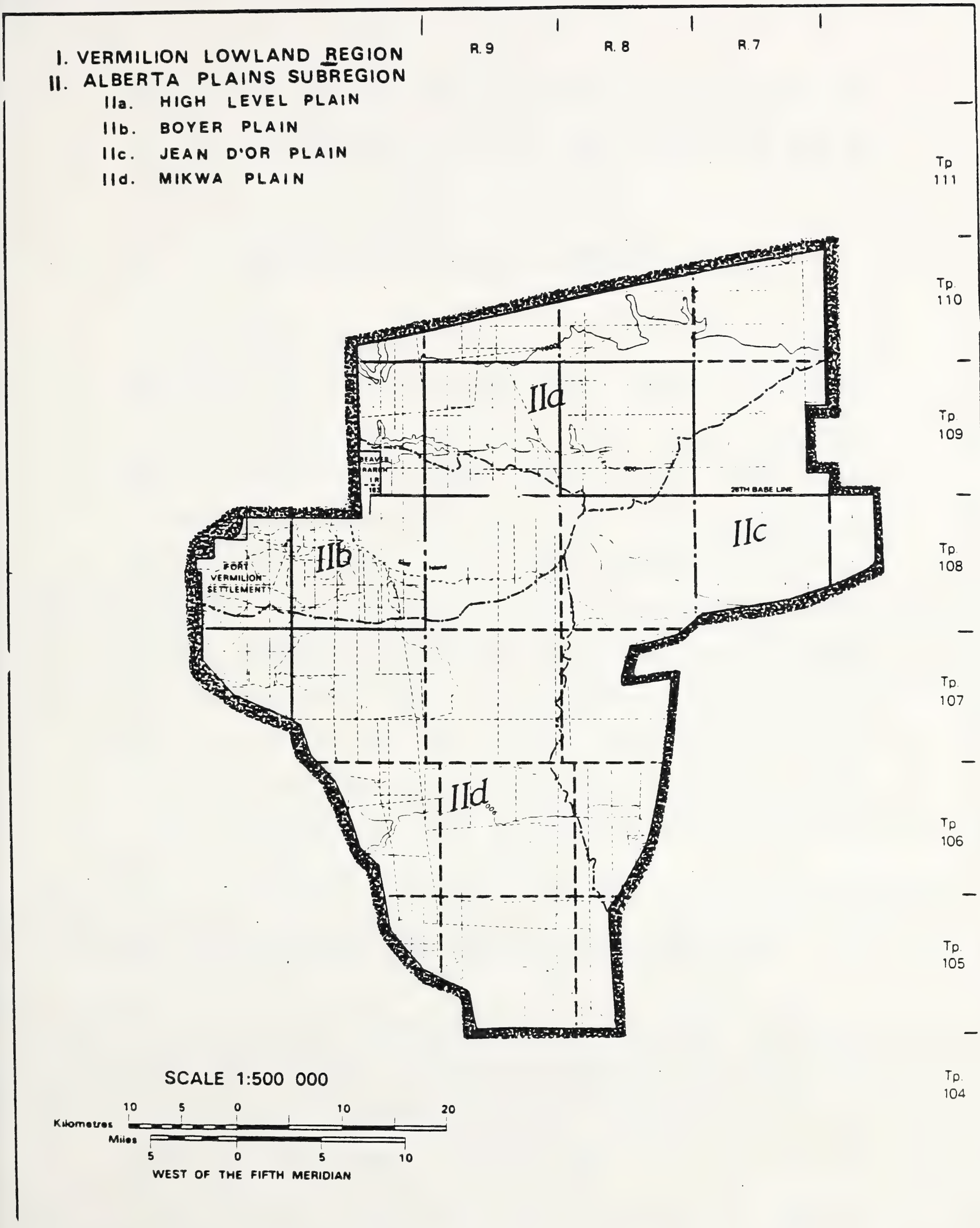


Fig.3 PHYSIOGRAPHIC SUBDIVISION OF THE JEAN D'OR PRAIRIE STUDY AREA

into the Jean D'Or Plain which consists of fluvial terrain which was deposited and molded by a much larger Peace River than at present.

3.2 High Level Plain Physiographic Sub-region

The entire sub-region contains thin, low relief sediments deposited in the shallow perimeters of Lake Tyrrell. The portion of the sub-region north of the Peace River in the study area appears to represent the northern perimeter of Lake Tyrrell. Thin glaciolacustrine sediments are the dominant surficial deposit in the sub-region. A small area of thicker sediments is found north of the Peace River in the eastern portion of the study area. Other surficial deposits in the sub-region are fluvial deposits associated with Beaver Ranch Creek, a small area of moraine in the north central part of the study area, bands of irregular north to south fluvio-lacustrine sediments and a small area of glaciofluvial sands in the extreme northeast. With the expection of the Beaver Ranch Creek, overall relief in the sub-region is low.

3.2.1 Glaciolacustrine Veneer Geomorphic System and Units

This geomorphic system represents processes that occurred at or near the perimeter of glacial Lake Tyrrell. Thin veneers of glaciolacustrine clays were deposited out of suspension onto fine-textured and slightly stony continental basal till. The high clay content of both the lake sediments and till are derived from the underlying Loon River shales. East to west trending flutings of

the basal till show up through the thin sediments of the lake deposits. The masked flutings are evident in the landscape as slightly poorly to very poorly drained depressions. The variation in relief from the fluting depressions to adjacent uplands is less than 3 m. The terrain's surface expression is primarily undulating with occasional level areas. The slopes fall within the zero to three per cent range.

Soil development in this system is influenced by the high salinity of the lake sediments. Soils located on the moderately well drained sites are the Gray Solodized Solonetz soils and Gray Solods of the Boyer series (Scheeler and Macyk 1972). The high salt content of these soils, particularly in the B and C horizons, are derived not only from the lake sediment parent material but also from regional groundwater discharge. Groundwater eminates from recharge areas on top of the Caribou Mountain and discharges at the base of the south-facing slopes coming off the mountain. Salts are replenished in the solum by groundwater discharge. The Gray Solodized Solonetz soils are the dominant soil subgroup on moderately well drained sites. They have a diagnostic leached and platy Ae horizon which overlies a solonetzic Bnt horizon. The Bnt horizon has a prismatic to columnar structure which has a very hard consistency when dry. Bnt horizons observed in the field ranged from seven to 35 cm below the surface of the mineral soil with 20 cm depths as the average. The Gray Solodized Solonetz soils are found in shallow depressions between slightly raised knolls. These

lower areas have slightly impeded drainage which results in reduced leaching of salts. A well-defined Bnt horizon is maintained because of the high salt concentration in the solum.

Associated with the Gray Solodized Solonetz soils are the subdominant Gray Solods. The Solods generally occur on the slightly raised knolls which have better drainage (well drained), resulting in more downward percolation. This washes salts deeper into the solum which creates a deeper Ae and a Bnt with columnar peds that show signs of disintegration. The Ae and Bnt horizons are separated by an AB horizon which represents the weak platy tops of a former Bnt column.

The large depressions are poorly to very poorly drained. The soils developed in these depressions occur in the respective Gleysolic and Organic orders. Humic Luvic Gleysols of the Snipe series (Scheelar and Macyk 1972) are found in small localized depressions surrounded by Gray Solodized Solonetz soils. The Humic Luvic Gleysols have a diagnostic Ah horizon which is 10 cm or greater in thickness underlain by Aeg and Btg horizons. The soil profile indicates humus accumulation in the Ah horizon, clay eluviation in the Aeg horizon and clay illuviation in the B horizon during dry periods of the year when drainage is good. However, a rise in the water table during critical parts of the year such as in spring results in impeded drainage in the A and B horizons. The soil becomes gleyed. As the drainage improves the soil dries out and reddish mottles indicative of iron oxidation become evident.

Linear depressions elongated in a west to east direction are the sites for very poorly drained Terric Mesisols. These linear depressions are lake sediment veneered glacial flutings which contained shallow lakes shortly after deglaciation. Fens gradually became established in these shallow water bodies. The gradual death and decay of the fen vegetation added organic material which resulted in the formation of Terric Mesisols. Field measurements revealed organic depths of less than one metre which make the Mesisols Terric rather than Typic. Poorly drained Orthic Humic Gleysols frequently occur around the perimeter of these organics.

3.2.2 Fluviolacustrine Geomorphic System and Units

Irregular fluviolacustrine systems running roughly north to south are found in the portion of High Level Plain sub-region within the study area. This system represents glaciolacustrine sediments which have been washed and reworked by fluvial sheet flow originating from the south-facing slopes of the Caribou Mountains. These reworked deposits overlie the glaciolacustrine as veneer. The terrain has an undulating surface expression with zero to three per cent slopes. Dominant soils on these washed sediments are moderately well drained Gray Solodized Solonetz soils of the Boyer series on upland sites. Gray Solods are the subdominant soils on the upland sites. Gray Solods are the subdominant soils on the upland terrain. In small depressions Humic Luvic Gleysols of the Snipe series are common. In larger very poorly drained depressions Terric Mesisols are dominant. Poorly drained Orthic Humic Gleysols

are frequently found bordering these organic areas.

3.2.3 Morainal Geomorphic System and Units

A small area of continental basal till extends south into the north central portion of the study area. This terrain is slightly elevated above the lake basin to the south and therefore was probably not inundated by Lake Tyrrell. The basal till has a clay texture similar to the lake deposits to the south. Glacial origins of the till is evident from the occasional subrounded stone. The surface expression of the till-covered terrain or moraine is predominantly undulating with occasional level areas. The range in slopes is zero to three per cent. The till has similar saline characteristics as the adjacent glaciolacustrine deposits. Both deposits have developed primarily from the underlying saline marine shales. Regional groundwater discharge originating from the Caribou Mountains to the north keeps the salt in both deposits at or near the surface. Soils developed on the moderately well drained positions of the till covered terrain are predominantly the Gray Solodized Solonetz soils of the Lawrence series. These soils are similar to the Solonetz soils of the Boyer series developed on glaciolacustrine deposits. Humic Luvic Gleysols of the Snipe series are found in the poorly drained depressions.

3.2.4 Glaciofluvial Geomorphic System and Units

A glaciofluvial channel that carried meltwaters south from the glaciated lower slopes of the Caribou Mountains into Lake Tyrrell

during glacial retreat is evident in the northeast corner of the study area. The coarse sand to sandy loam deposits indicates deposition by fast moving water. The deposits were laid down as a blanket over finer textured morainal deposits. The geomorphic unit in the northeast corner of the study area represents the southern portion of a system which extends north beyond the study area. The terrain in this system is undulating to level with slopes no greater than three per cent. The soil developed on the rapidly drained glaciofluvial deposit is the Clouston series Eluviated Eutric Brunisol (Scheelar and Macyk 1972). This soil subgroup has a diagnostic leached and platy Ae horizon overlying a reddish oxidized Bm horizon. The sand deposits do not contain enough clay for translocation from the A horizon into the B horizon, thereby forming a Bt horizon.

3.2.5 Deep Central Basin Glaciolacustrine System and Units

Deep deposits of silty clay loam glaciolacustrine sediments are found southwest of the Jean D'Or Prairie Indian Reserve north of the Peace River. Buried glacial flutings also occur in this system, however, they are not as evident as those in the glaciolacustrine area to the north. The undulating to level glaciolacustrine deposits have zero to three per cent slopes. The sediments have a silty clay loam texture. The coarser textures of these central basin deposits compared to the clays of the perimeter suggest deposition in Lake Tyrrell when it was smaller in size and more turbulent. The soils developed on these deep basin

deposits are mainly Orthic Gray Luvisols of the Davis series on moderately well drained sites. Any salts present have been leached out of the solum and therefore no solonetzic characteristics are evident. In poorly drained local depressions, Humic Luvic Gleysols of the Wanham series are common (Scheelar and Macyk 1972). These soils exhibit A eluvial horizons and B illuvial horizons which experience periodic gleying during the year. Thin fen veneers over glaciolacustrine sediments are the parent material for very poorly drained Terric Mesisols. Around the perimeter of these level, organic-filled depressions poorly drained Orthic Humic Gleysols occur in the zone of gradation from Mesisols to Luvisols.

3.2.6 Beaver Ranch Creek Fluvial System and Units

Portions of the Beaver Ranch Creek fluvial system occur in the northeastern corner of the High Level Plain sub-region within the study area. Geomorphic units within this system consist of floodplain deposits with an undulating surface expression. Terrain slopes fall within the zero to three per cent range. The fluvial deposits have a silt loam texture. The creek which has incised a channel into the terrain has steep valley walls with slopes in the 45 to 70 per cent range. Soil development on fluvial deposits is poor due to the frequent flooding that occurs in the creek valley. Soils which have developed on these frequently disturbed sediments are the Cumulic Regosols. These soils contain Ah horizons which have been buried by silt loam deposited by floods.

3.3 Boyer Plain Physiographic Sub-region

The portion of the Boyer Plain sub-region in the study area represents the lower portion of a Pleistocene delta deposited into Lake Tyrrell during a period of standstill in its history. Recent deposits of the Peace River are also included in this sub-region. Most of the sub-region in the study area consists of a fluvial geomorphic system with a small unit of glaciolacustrine veneer over moraine.

3.3.1 Fluvial System and Units

This system represents a remnant of a Pleistocene delta which developed in Lake Tyrrell. The undulating to level fluvial deposits in this system have a loamy sand texture. These deltaic deposits form a veneer over silty clay loam glaciolacustrine sediments. The recent Peace River sediments occur on the floodplain and terraces. They have a silty loam and sandy loam texture with occasional gravels mixed in. The soils developed on the deltaic veneers are classified as Eluviated Eutric Brunisols of the Culp series (Scheelar and Macyk 1972). These Brunisols have a diagnostic Ae horizon underlain by an oxidized, reddish Bm horizon. According to Scheelar and Macyk (1972), Orthic Gray Luvisols are complexed with eluviated Eutric Brunisols in the Culp series. No Luvisols were observed during the field investigations. In the lower poorly drained sites in the midst of Culp soils, Wanham

series Humic Luvic Gleysols are found. Isolated, low lying depressions in this system contain poorly drained fen veneers over fluvial sediments. Soil developed in these fens are Terric Mesisols. Orthic Humic Gleysols are found in the fen perimeter.

Recent Peace River alluvium on fluvial terraces southeast of the Beaver Ranch Creek Indian Reserve ranges in texture from sandy loam to silt loam. The surface expression is undulating with one to five per cent slopes. Soils developed on terrace deposits are predominantly moderately well drained Dark Gray Luvisols and less common imperfectly drained High Prairie series Gleyed Dark Gray Luvisols. The Dark Gray Luvisols are characterized by a thick Ah and Ahe horizons which exceed the 5 cm minimum thickness necessary for classification into the Dark Gray Luvisol category. These horizons are underlain by diagnostic Ae and Bt horizons. The humic material added to the solum to form the Ah and Ahe horizons is derived from decayed grass and shrub vegetation which grows in natural open grasslands.

The most recent fluvial deposits are found on the floodplain islands of the Peace River in the Boyer Plain sub-region. The floodplain experiences frequent flooding which adds fresh silt loam material and occasional gravelly silt loam deposits. The terrain has an undulating surface expression with slopes one to three per cent and occasionally as high as five per cent. The frequent flooding has restricted soil development to moderately well drained Cumulic Regosols and poorly drained Rego Gleysols on the floodplain islands.

3.4 Jean D'Or Plain Physiographic Sub-region

This sub-region represents a lowland area adjacent to the Peace River and Lower Wabasca River which were affected by fluvial geomorphic processes shortly after deglaciation. Terrain elevations range from 260 masl (850 ft.) to 300 masl (1 000 ft.). Fluvial deposits vary from thin veneers over glaciolacustrine sediments to floodplain deposits.

3.4.1 Fluvial Veneers System and Units

Before the Peace River incised its present channel, a wide channel of water flowed into Lake Tyrrell. The river flow deposited coarse fluvial sediments over finer glaciolacustrine material. These sediments appear to be associated with the lower portion of a delta that formed into Lake Tyrrell. North of the present Peace River, there are remnants of old channels which were part of a braided network of streams that flowed into the glacial lake. These abandoned channels are now linear, poorly to very poorly drained depressions in which organic deposits have collected. Recent fluvial deposits are found on the terraces and the floodplains of the Wabasca and Peace Rivers.

The expression of the landscape in the area overlain by fluvial deposits over glaciolacustrine sediments is generally undulating to occasionally level with slopes in the zero to three per cent range. Soils developed on well drained deposits are

Eluviated Eutric Brunisols of the Culp series (Scheeler and Macyk 1972). These soils have a diagnostic leached and platy Ae horizon over a reddish Bm horizon with little evidence of clay eluviation. Fluvial veneers located around the perimeter of local poorly drained depressions are generally overlain by Humic Luvic Gleysols of the Wanham series (Scheeler and Macyk 1972). These soils are experiencing clay leaching during dry periods. During saturated conditions gleying occurs in the upper A and B horizons.

The very poorly drained organic-filled depressions have a horizontal surface expression and consist of fens underlain by Terric Mesisols with occasional Orthic Humic Gleysols around the perimeter.

Fluvial deposits associated with the recent Peace and Wabasca Rivers occur on terraces and floodplains. The terraces have an undulating surface expression with slopes in the one to three per cent range and occasionally as high as five percent. Slopes descending from the upper terraces to the floodplains range from 16 to 70 per cent. Soil development has been allowed to take place on the terraces where flooding no longer occurs. Soils developed on the silty clay loam textured material falls within the Dark Gray Luvisol subgroup. In poorly drained local depressions, Humic Luvic Gleysols and Orthic Humic Gleysols are found.

The floodplain has an undulating surface which corresponds to the ridges and swales of the point bars located inside the meander

bends and on islands in the river channel. The slopes are short and range from one to five per cent. Soil development on the flood- plain is impeded by flooding which frequently occurs in the Peace and Wabasca Rivers. On the well drained silt loam deposits, Cumulic Regosols containing buried Ah horizons are found. In the swale depressions, poorly drained Rego Gleysols and occasionally imperfectly drained Gleyed Regosols are found.

3.5 Mikkwa Plain Physiographic Sub-region

The Mikkwa Plain sub-region represents a broad area of glaciolacustrine deposits south of the Peace River. The expanse of this former lake bottom is dissected by the Bear river and its associated tributary, along with a broad area fluviolacustrine veneer over glaciolacustrine sediments.

The overall terrain is flat with microtopographic variations in relief. Elevations rise from minimums of approximately 260 masl (850 ft.) in the northeastern part of the sub-region to slightly over 460 masl (1 500 ft.) in the southern part of the study area. Geomorphic systems within the area covered by lake bottom sediments were separated on the basis of the thickness of glaciolacustrine sediments over moraine. The remainder of the system represents fluvial deposits and thin fluviolacustrine veneers.

3.5.1 Deep Glaciolacustrine Geomorphic System and Units

This system occurs in the deepest and lowest part of the lake Tyrrell basin. The sediments completely mask any surface configurations of underlying deposits such as morainal flutings. The sediments themselves have an influence on the microtopographic surface expression. These forms are evident as "humpies" (Odynsky 1971). Humpies occur as fields of mounds in lacustrine basins adjacent to major stream courses such as the Peace River. Odynsky describes the plain view of humpies as roughly circular in shape, often having central depressions. In the study area, the mounds vary no more than one to two metres in height with slopes zero to three per cent. Various theories have been developed to explain how humpies were formed. Mathews (1963) suggests movement of water saturated soil during permafrost formation, while Kellog and Mathews (in Odynsky 1971) indicate processes similar to those forming Arctic pingos.

The undulating microtopographic surface expression greatly influences the type of drainage conditions and soils found in a field of humpies. The mounds are generally moderately well drained with orthic Gray Luvisols of the Davis series (Scheeler and Macyk 1972) developed on silty clay loam-textured glaciolacustrine material. These deposits are deep enough so that they are not affected by the salts inherent in the underlying morainal material. Water infiltration has kept salts out of the solum.

The intermound depressions are usually poorly to very poorly drained. Where drainage conditions are poor Humic Luvic Gleysols of the Wanham series are found. Terric Mesisols developed in fens occurs where the drainage is very poor. This system also has open water bodies which vary in size and configuration depending upon the prevailing climatic conditions. During wet periods the ponds are large, while during dry spells the ponds diminish and often dry up completely.

3.5.2 Thin Southern Perimeter Glaciolacustrine System and Units

This system represents shallower glaciolacustrine deposits laid down close to the perimeter of Lake Tyrrell. Visible through the lacustrine blanket are numerous southwest to northeast trending flutings of the underlying basal moraine. Also, humpies are more evident in this system than in the previous one. The terrain is undulating with zero to two per cent slopes. The terrain has microtopographic undulations with occurrences of ridges and depressions.

The blanket thickness of the glaciolacustrine material over moraine has had an influence on the soil type and drainage. On the moderately well drained clay glaciolacustrine deposits, Solonetzic Gray Luvisols of the Cadotte series are found. Solonetzic characteristics imparted to the Gray Luvisols are mainly due to the fine texture of the lake deposits which impede the downward percolation of water, and the close proximity of the saline morainal material to the surface.

The Solonetzic Gray Luvisols have a diagnostic Ae horizon depleted of clays and underlain by an AB horizon, which grades into a diagnostic Btnj horizon (15 to 20 cm below the surface). In terms of structure, the Ae is fine, platy while Bntj has very firm, subangular, blocky peds with well developed clay skins. The firmness of the peds in the Bntj horizon is a result of the high salt content in the B horizon. Vast areas of poorly drained Orthic Humic Gleysols are common, along with small isolated depressions of very poorly Terric Mesisols developed in fens. These wet areas occur in fluting depressions.

3.5.3 Bear River Fluvial Geomorphic System and Units

A small area of thick glaciolacustrine sediments is mapped in the southwest corner of the study area. An aerial view of this system shows a series of parallel ridges and depressions which appear to be associated with dropping levels in Lake Tyrrell. The system has a microtopographic undulating surface expression with zero to three per cent slopes.

Soils developed on moderately well drained sandy clay loam lake deposits consist of Orthic Gray Luvisols of the Davis series. Vast areas of poorly drained sites are overlain by Humic Luvic Gleysols and Orthic Humic Gleysols. Terric Mesisols are found in very poorly drained fens.

3.5.4 Fluviolacustrine Geomorphic System and Units

South of the Peace River is a system representing a broad area of fluviolacustrine sediments which was probably formed by sheet flow which occurred shortly after the lowering of Lake Tyrrell. It appears that the sheet flow was from north to south across a height of land that was above the level of Lake Tyrrell during its waning stages.

The overall macrorelief is low. The microrelief consists of undulating, irregular uplands and level depressions cutting across in a north to south direction across fluted terrain. These depressions represent the last vestiges of channels that drained waters to the south. The surficial deposits consist of a veneer of clay loam fluviolacustrine material over clay glaciolacustrine deposits. Soil development on fluviolacustrine material are similar to the soils in the surrounding glaciolacustrine deposits. Moderately well drained fluviolacustrine material is parent material for Solonetzic Gray Luvisols of the Cadottee series (Scheeler and Macyk 1972), while poorly drained depressional areas contain Humic Luvic Gleysols of the Snipe series and occasional Orthic Humic Gleysols. The latter soil subgroup occurs at the perimeter of deeper depressions containing veneers of organic deposits over glaciolacustrine sediments. Terric Mesisols have developed on this organic material.

3.5.5 Wabasca River Fluvial Geomorphic System and Units

This fluvial geomorphic system corresponds to the floodplain and terraces of the left bank of the Wabasca River in the Mikkwa Plain sub-region of the study area.

The terrain of the floodplain is primarily undulating with slopes no greater than three per cent. Slopes ranging from 16 to 70 per cent rise from the floodplain to the lake basin upland and higher terraces. Frequent flooding has restricted soil development to Cumulic Regosols on silt loam fluvial sediments.

The terraces are no longer affected by the disruptive floodwaters of the Wabasca River. The terrain of the terraces has an undulating to gently rolling topographic expression. Slopes are slightly greater, ranging from three to nine per cent.

Soil development has been allowed to take place here due to the stable conditions. Soil subgroups found on moderately well drained silt loam deposits are Orthic Gray Luvisols of the Davis series (Scheelar and Macyk 1972) development mainly under aspen vegetation. Dark Gray Luvisols occur under open grasslands, where organic accumulation is sufficient for the development of an Ah horizon over an Ae and Bt horizon.

3.5.6 Deep Glaciolacustrine Geomorphic System and Units

A small area of deep glaciolacustrine sediments occurs in the extreme southwest corner of the study area. The deposits are deep enough to completely mask the irregularities in the underlying moraine terrain. A series of parallel west-southwest to east-northeast running ridges appear to represent old shorelines of Lake Tyrrell as it rapidly receeded to the south. The surface expression of the terrain is generally undulating with slopes zero to three per cent.

The soils on moderately well drained sandy clay loam show no effects of salinity in the form of hard Bntj or Bnt horizons. Instead, the soils are Orthic Gray Luvisols of the Davis series. The diagnostic horizons consists of a platy and leached Ae horizon over a Bt horizon rich in illuvial clays. Poorly drained sandy clay loam glaciolacustrine deposits are overlain by Humic Luvic Gleysols and occasional Orthic Humic Gleysols. Poorly drained fen veneers over glaciolacustrine sediments are the parent material for Terric Mesisols.

CONCLUSIONS AND RECOMMENDATIONS

Considerable scope exists for further exploration and assessment of the land classification in the Jean D'Or Prairie and surrounding districts. In this report emphasis has been directed toward outlining broad geological, geomorphological, landform and soil aspects of the Jean D'Or Prairie area. In addition, it is hoped that some useful guidance has been given which can be utilized by the Resource Evaluation and Analysis Section of the Resource Evaluation Branch. Further study will, of necessity, have to be of a more local and detailed nature.

As has been pointed out in the text, several buried stream channels have been located within and to the west of the study area. Apparently considerable groundwater supplies exist in the area. It is therefore recommended that further detailed work outlining the nature and extent of these channels be undertaken, particularly in an area to the north of the Peace River.

With respect to potential environmental problems, attention should be focused on the Peace and Athabasca River valleys, where recent fluvial processes have resulted in the development of floodplains, poor drainage, terraces, and in parts, steep valley slopes. Surface disturbance in the form of erosion in the Jean D'Or Prairie does not constitute a major problems mainly because of the prevailing low topographic relief throughout the area.

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